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Systems Center
San Diego

Pacific Science
& Engineering

Knowledge Web (K-Web)

Increasing Speed of Command Using Web-Enabled Technologies

www.pacific-science.com/kmds
www-tadmus.spawar.navy.mil

Knowledge Engineering Identifies Common Operational Issues

Information not where or in form it is needed.

- **Data organization & presentation based on where it is coming from vice where & how it is needed.**
- **Multiple hardware stovepipes hinder distribution & impede speed of command.**

Difficulty identifying what information is valuable to whom / when

- **Not aware who is using information generated by J codes**
- **No idea what form information should take - what is "value added"**
- **Many legacy information products being produced – not sure why**
- **Collaboration across organizational codes ad hoc and awkward if it happens at all.**
- **Staff meetings limited by prescribed slide presentations. Typically: 90 Minutes spent reviewing status, followed by 20-30 minutes of discussing significance and impact, making command decisions.**

Aegis CIC – CJTF JOC – CVN TFCC – USMC ROC

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A Common Theme…

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These commands are sharing knowledge in distributed, asynchronous, environment with multi-echelon and coalition environments to contend with.

Propose that command center CONOPS focus on:

- **Shared relevant Knowledge (vice shared data)**
- **Shared Awareness**
- **Speed of Command**

Related Research Findings: Emerging Requirements

Military Command Centers:

- Research conducted, lessons learned, and evolving needs of Navy have revealed requirement for tools to support:
  - » Improved Situation Awareness / Assessment
    - Perception of Data Patterns
    - Alerting / Attention Management
    - Memory augmentation for Dynamic Events
    - Situation-based Data Fusion
  - » Dynamic, synchronous and asynchronous collaboration
    - Distributed Cognition
    - Adaptive information flow and team structure
  - » Adaptive, real-time resource and action management and planning support

Related Cognitive Tasks Analyses: Common Information Requirements

Tactical data (multiple views if possible!)
- **Map-based and highly graphical views / context**

Mission Summaries and Commander's Intent

Real-time info! (or close to it)

Alerts / Advisories / Recommendations
- **What isn't working according to plan? & What do we do to fix it?**

Impacts & Indications
- **"X" happened; how does it affect everything else?**

Plans (and alternate COAs)
- **Response & Timeline Management**

Effects Summaries
- **Various formats preferred**

Asset / Resource Management

Collaboration Tools (including VTC)

Common Processes / Tasks Observed in Command Centers

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Develop / share "Situation Awareness"

- Monitor tactical picture and other mission-relevant information
- Extract / filter relevant information
- Develop summary graphics & presentations
- Communicate / disseminate mission-relevant information

Collaborate within and across echelons

- Synchronous and asynchronous
- Face-to-face and distributed
- Common and relatively unrelated goals / objectives

Make Mission-Related Decisions

- Time- or mission-critical
- Based on incomplete and/or ambiguous information

Problem: *Available tools don't adequately support above processes / tasks!!*

What is the Knowledge Web?

A Concept of Operations for using the web to improve effectiveness of command & control.

Objective is to:

- **Increase Speed of Command**
- **Facilitate Collaboration & Information Sharing**

Basic Concept:

- **Capture the value-added information (i.e., *Knowledge*) already being created by the command staff.**
- **Share the "best available information" at all times**

Knowledge Web can be organized dynamically to meet warfighter needs

Store and present this Knowledge in an easily accessible environment – a *Knowledge Web*

What Knowledge Web is NOT!

- **Not a specific technology** ***(Prototyped on an Microsoft IIS-based web server, deployed with "Collaboration At Sea" / Lotus Domino servers)***
- **Not yet widely deployed** ***(currently, deployed to five Battle Groups – prototype systems elsewhere)***
- **Not yet a "finished" product** ***(R&D, and transition efforts are still underway…)***
- **Not a "real-time" tactical tool** ***(The K-Web is a "dynamic status board" where you are trying to share the "best available" information at all times across the entire command.)***
- **Not just a library of links to files** ***(The K-Web is part of your collaboration space – it is the table in a library.)***

Knowledge Web Concept

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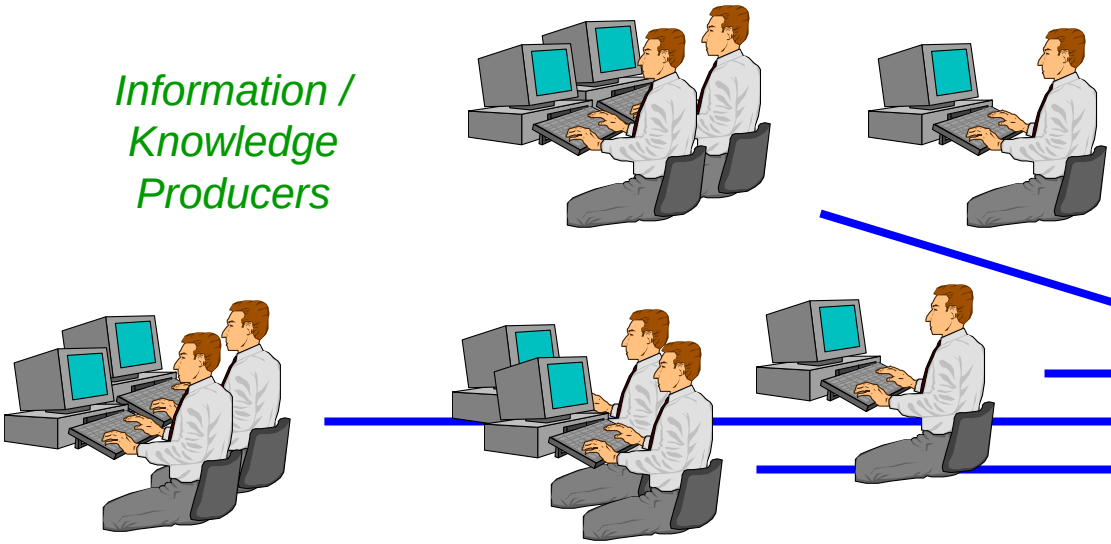
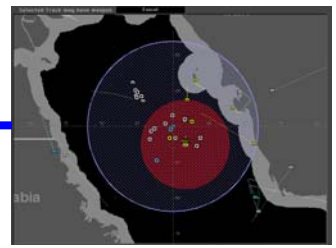
Information / Knowledge Producers

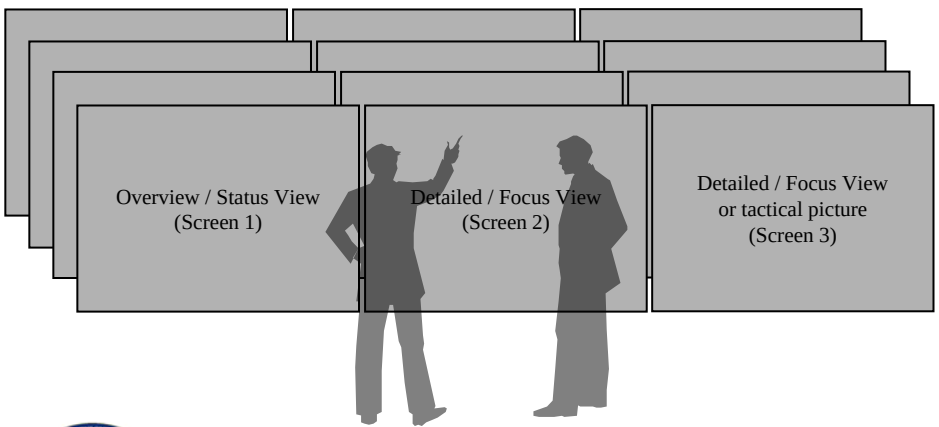


Server(s)

Tactical Picture(s)

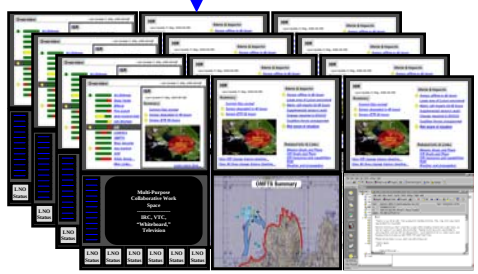


Other Info



Knowledge Wall Users

Information Consumers



Knowledge Desks

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USS Carl Vinson's TFCC
as used by CARGRU THREE during OEF

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CNAP
Video Wall
(Integrating SSC-SD Knowledge Wall concepts and technologies)

SSC-SD provided 3 Knowledge Desks


Video Wall
2x4 Matrix of Projector Cubes
K-Desks (3)
2x3 Matrix of LCDs

Typical K-Web Products

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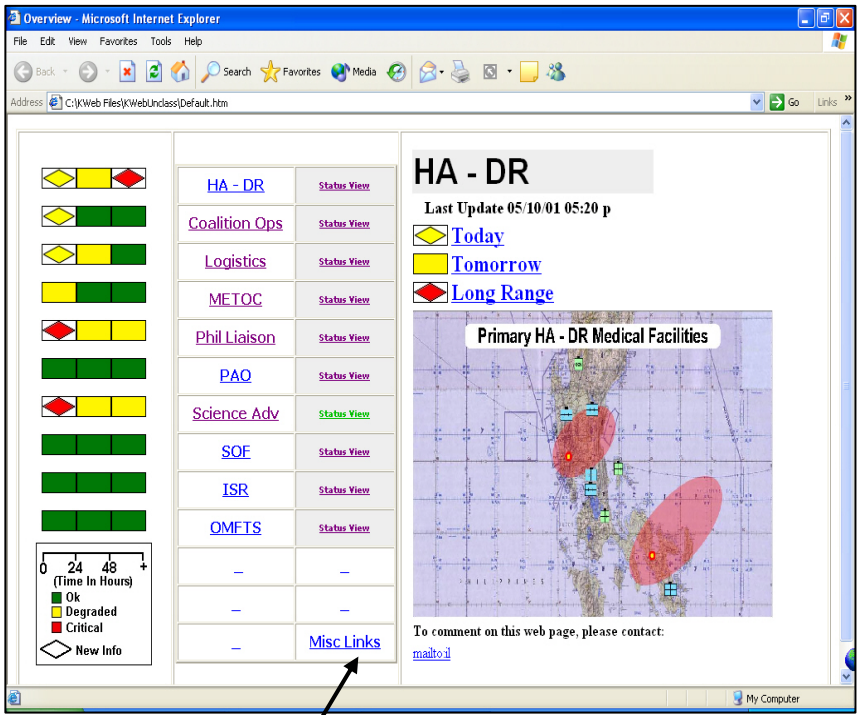
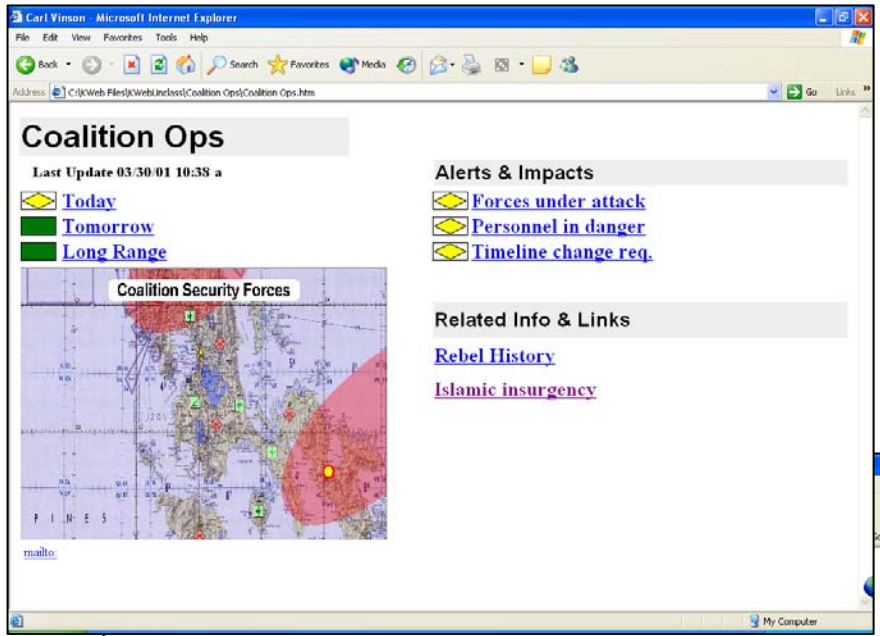
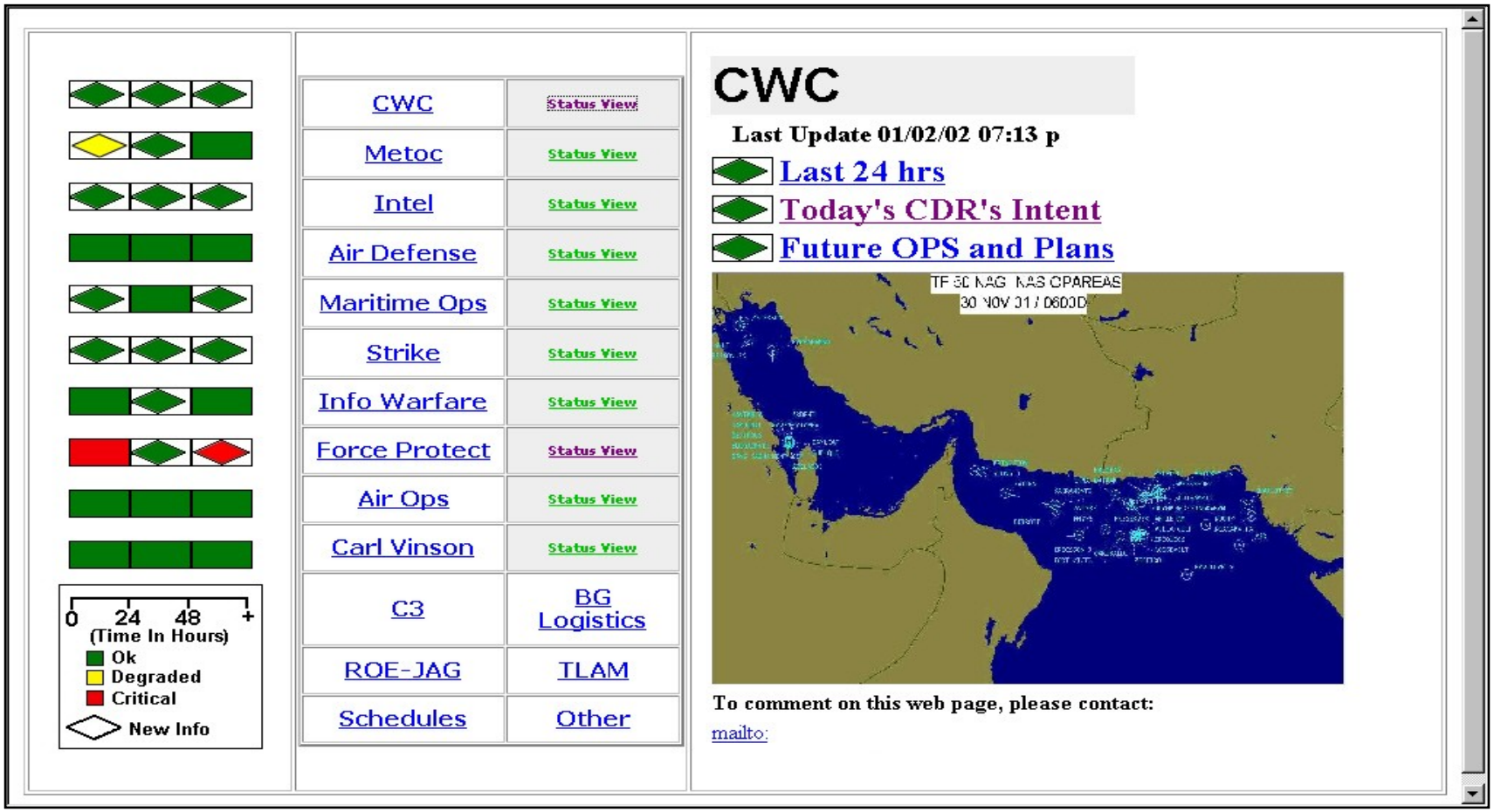


K-Web Overview Page



Summary and Lower-level Content Pages

CCG-3 K-Web Overview Page



Functional Area Organization

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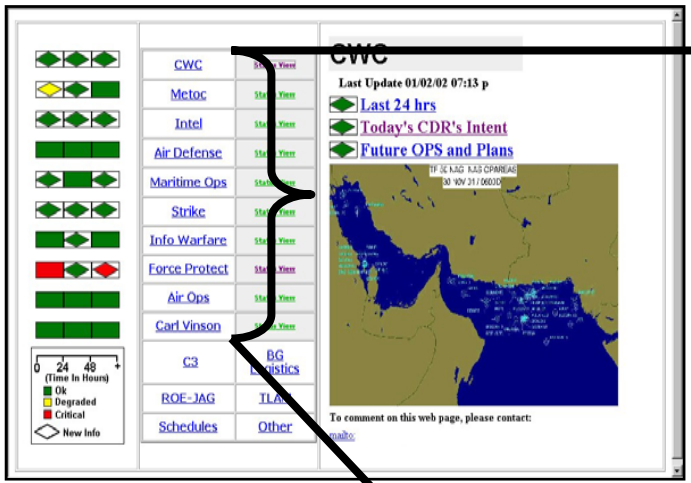
Overview Page



Functional Areas represented on Carl Vinson K-Web

PAGE TITLES	FUNCTIONAL AREA REPRESENTED
(CWC)	Composite Warfare Commander (the overall summary page for RADM Zelibor)
METOC	Meteorology and Oceanography
INTEL	Intelligence
AIR DEFENSE	Air Defense
MARITIME OPS	Maritime Operations
STRIKE	Strike
INFO WARFARE	Information Warfare
FORCE PROTECT	Force Protect
AIR OPS	Air Operations
CARL VINSON	USS Carl Vinson
C3	Command, Control and Communications
ROE-JAG	Rules of Engagement / Judge Advocate General
SCHEDULES	Schedules
BG LOGISITICS	Battle Group Logistics
TLAM	Tomahawk Land Attack Missile

"Other" was a hyperlink to numerous lower-level Summary Pages and information available within the K-Web

Typical CCG-3 K-Web Summary Page

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Intel

Last Update 11/25/01 09:49 a

- Intel SITREP
- Indications and Warning Log
- Collections/Systems

INN DELHI DDG

UNCLASSIFIED

To comment on this web page, please contact:

mailtc

Alerts & Impacts

- Atta's Post-War Plans
- Anti-Taliban Primer
- Kandahar Situation
- Arabs Flee Afghan in Disguise
- Small Boat Interdiction
- Messages of Interest
- Current OPINTEL

Related Info & Links

USS CARL VINSON CVIC Homepage

BF 50 BDA

Return to Intel Brief

Return to Sample KWEB

Sample Underlying Content Page

OPINTEL
Pakistan

- GEOPOL
- Naval Activity
- MARPAT Activity
- Air Activity
- Air Defense Activity
- Emitter Activity
- Ground Activity
- Terrorist Activity

- PK Protest Page
- JICPAC Pakistan PTMIG page
- Pakistan Recent Nuclear Activity as of 28JUL
- Tactical Activity Log
- PK Plotsheets
- Pakistan INTEL BRIEF
- Pakistan's Intelligence and Security Services
- Afghanistan Page
- PK AOB.jpg

Page Maintained By Supplementary Plot (SUPPLOT) Knowledge Manager (SKM)

- e-mail: SKM@ccg3.navy.smil.mil
- Chat name: CVIN_RDBM
- J-dial: 6220

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CCG3 INTEL - BDA Spreadsheet

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DATE (MISREP)	FACILITY NAME (Pre-strike imagery)	BHA (WSV)	BDA (Post-strike imagery)	WEAPON	ACFT	PKG	DMPI DESCRIPTIO	DMPI	BE NUMBER	PILOTS' COMMENTS/	MSN NUM
11/25/01	12P	N/A	N/A	N/A	N/A	CAS 3	COMPOUND	CMPND	12P	MES gun fight, missile shot	
11/17/01	10G	HIT	Pending	Bomb1	Fighter1	SCR 2	VEHICLE	VEH	10G	No luck for guys that get out of vehicle and	
11/17/01	17P	HIT	Pending	Bomb1	Fighter1	XCAS 4	TRUCK	TRUCK	17P		2543
11/16/01	17P	HIT	Pending	Bomb1	Fighter1	XCAS 3	TROOPS IN BLDG	TROOPS	17P		
11/14/01	16P	HIT	Pending	Bomb3	Fighter2	INT 4	BARRACKS	BKS	16P	Entire area lit up	
11/12/01	17L	HIT	Pending	Bomb5	Fighter1	SCR 5	VEHICLE	VEH	17L		2605
11/10/01	16P	HIT	Pending	Bomb5	Fighter1	SCR 2	VEHICLE	VEH	16P		
11/8/01	QANDAHAR MOTOR TRANS FAC	HIT	DESTROYED	Bomb4	Fighter1	SCR 2	POL STORAGE	AOM499	0442CA0035	Contiunuing explosion	
11/6/01	KESHENDYA PAIN DSA	HIT	Pending	Bomb1	Fighter1	FAC 4	VEHICLE	VEH	0337ST0008		2705
11/5/01	13O	HIT	Pending	Bomb1	Fighter1	FAC 2	TROOPS	TROOPS	13O		2703
11/1/01	12O	HIT	Pending	Bomb1	Fighter1	SCR 4	VEHICLE	VEH	12O		2605
10/29/01	17L	HIT	Pending	Bomb1	Fighter1	SCR 3	VEHICLE	VEH	17L		
10/27/01	HOSEYNKUT ARMY BKS	HIT	PROB DESTROY	Bomb5x2	Fighter1	FAC 7	BUILDING	BLDG	0431-00160		2703
10/7/01	FARAH EW RADAR FAC	HIT	DESTROYED	Bomb1	Fighter1	B	CTR OF SPT BLDG	AOG475	0430CA0085		
10/7/01	HERAT AFLD	HIT	DESTROYED	Bomb1	Fighter1	B	CTR RWY	A20306	0430-08400	Hit one MIG-21	

Evolution of Data to Information to Knowledge: METOC Example

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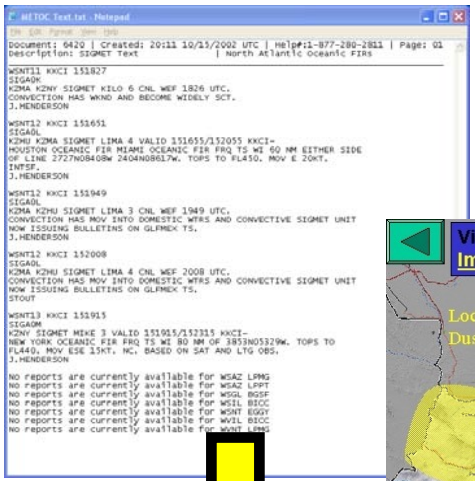
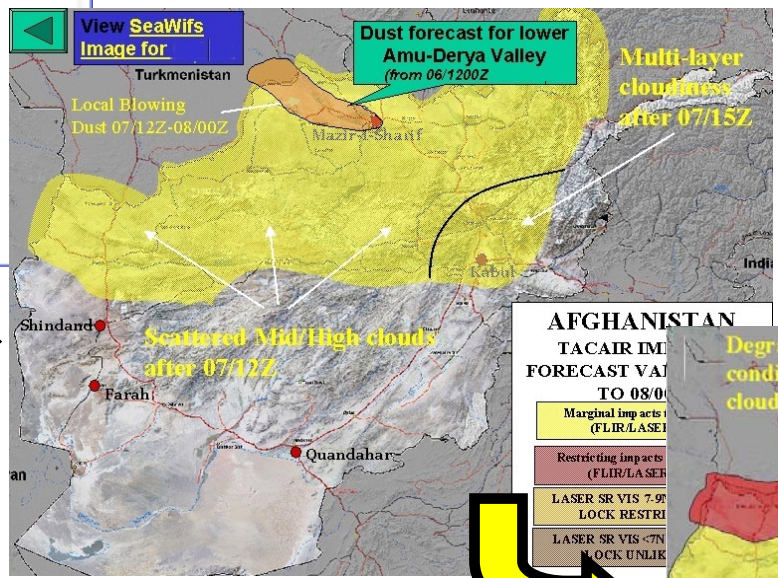
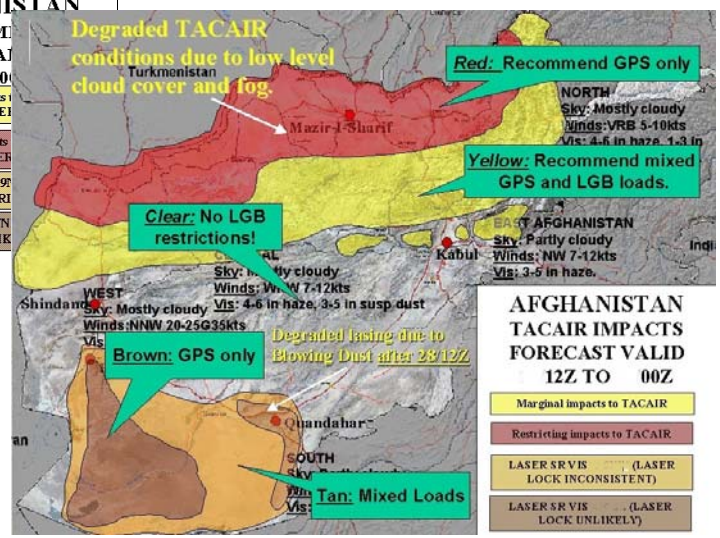


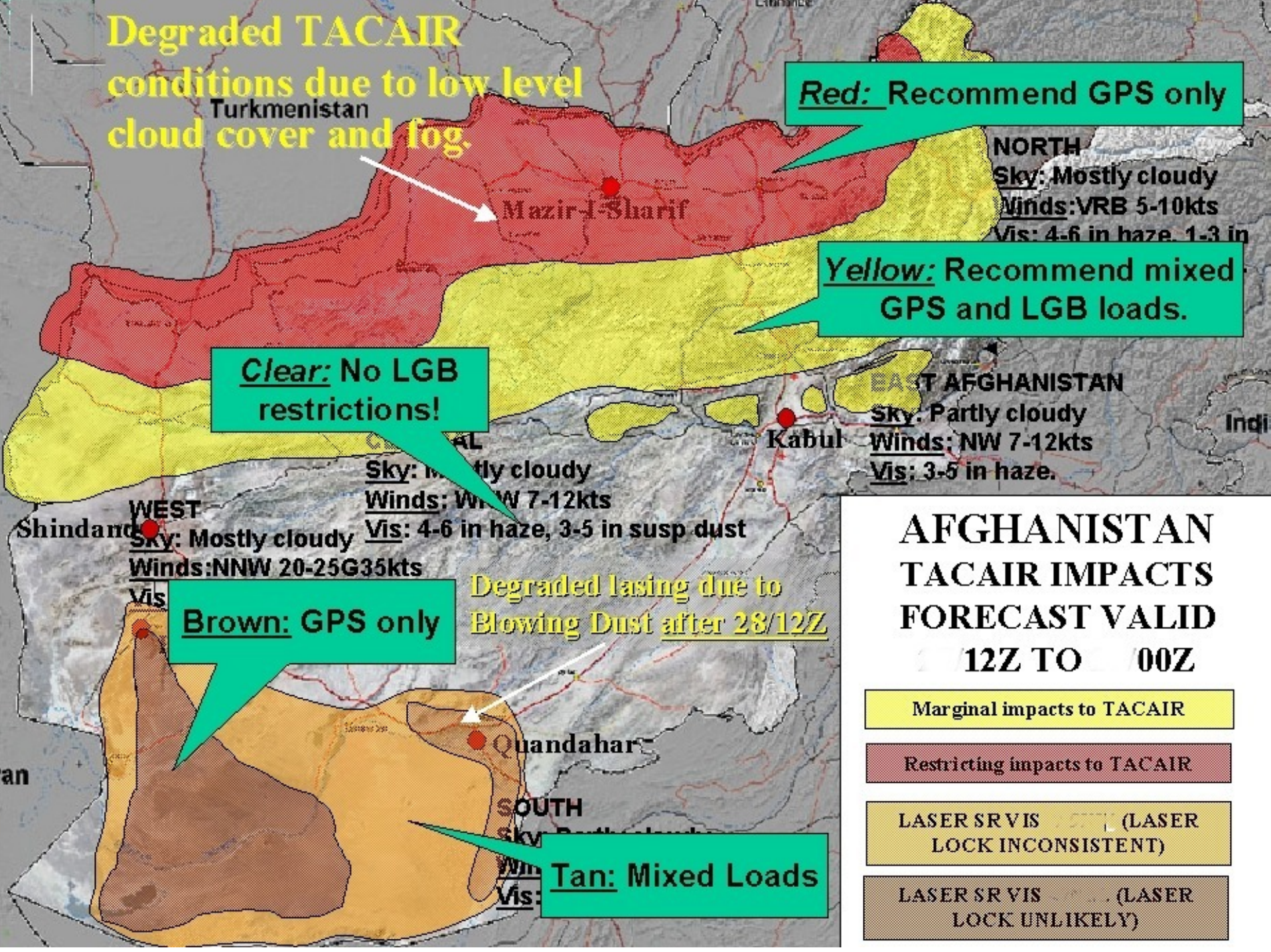
Data: Typical Text-based weather product



Information: raw and semi-processed data represented graphically



Knowledge: weather data and info translated into usable, understandable *Knowledge* of immediate value to planners and pilots


Degraded TACAIR conditions due to low level cloud cover and fog.
Turkmenistan
Red: Recommend GPS only
NORTH
Sky: Mostly cloudy
Winds:VRB 5-10kts
Mazir-I-Sharif
Yellow: Recommend mixed GPS and LGB loads.
Clear: No LGB restrictions!
EAST AFGHANISTAN
Sky: Partly cloudy
Winds: NW 7-12kts
Vis: 3-5 in haze.
Kabul
Sky: Mostly cloudy
Winds; NW 7-12kts
Vis: 4-6 in haze, 3-5 in susp dust
WEST
Shindand
Sky: Mostly cloudy
Winds:NNW 20-25G35kts
Brown: GPS only
Degraded lasing due to Blowing Dust after 28/12Z
Quandahar
SOUTH
Tan: Mixed Loads
AFGHANISTAN
TACAIR IMPACTS
FORECAST VALID
12Z TO 00Z
Marginal impacts to TACAIR
Restricting impacts to TACAIR
LASER SR VIS (LASER LOCK INCONSISTENT)
LASER SR VIS (LASER LOCK UNLIKELY)

Important K-Web Principles

Flexibility

- K-Web must be easily and rapidly adaptable to warfighters' changing needs
  - » Form
  - » Content
  - » Web / knowledge structure

Ease of Use

- Intuitive and easy-to-use
  - » Information production
  - » Information consumption
    - ◆ Limit required user interaction to the extent possible

Economy of Effort

- Leverage off of information tools and products already being used / produced
  - » Outlook / Exchange, Word, Excel, PowerPoint, Access, various graphics, multimedia, others' web sites / content, etc.
  - » Limit production of specialty products
- Require little or no maintenance by IT personnel

Building and Maintaining a Knowledge Web

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Warfighters shouldn't be Web Masters!!

Tools have been developed to do the "web work"

- **Summary Maker is a template-based tool to build Summary Pages**
- **TacGraph facilitates development of map-based summary graphics with imbedded, web-accessible information**

The *hardest part of information production remains unchanged* – figuring out how to create and present value-added information (i.e., *Knowledge*) that tells the right story

Knowledge Walls (K-Wall)

as installed at the Naval War College

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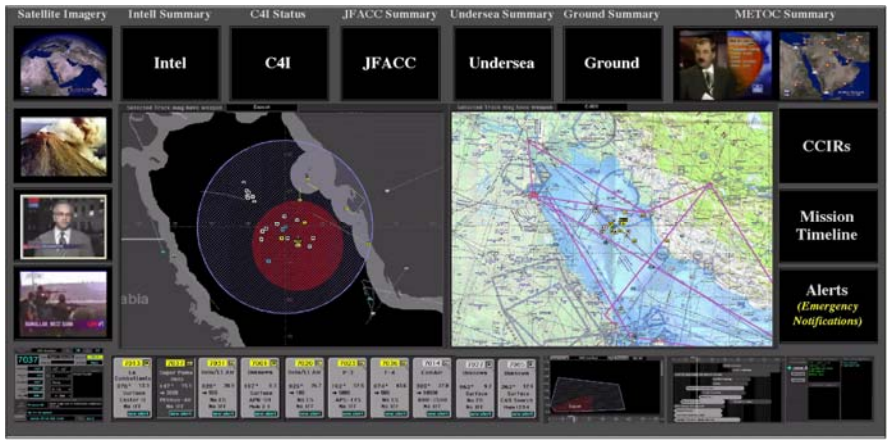

Command 21 Knowledge Wall Conceptual Design (ca 1999)

Global 2000 Knowledge Wall

Global 2001 Knowledge Wall

Knowledge Web (K-Web):
Use by CARGRU THREE aboard the USS Carl Vinson During Operation Enduring Freedom

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Pacific Science & Engineering Group
Ronald Moore
ramoore@pacific-science.com

USS Carl Vinson / CCG-3 K-Web Timeline

Oct 1999	K-Web development begins – C3F Requests accelerated development for Global 2000
Aug 2000	CCG-3 participates in Global 2000 War Game
Oct 2000	CCG-3 requests K-Web installation
Apr 2001	K-Web tools approved for use aboard ship
May 2001	K-Web / K-Desk installed onboard USS Carl Vinson
Jul 2001	USS Carl Vinson / CCG-3 deploys
Sep 2001	Terrorist attack on World Trade Center / Operation Enduring Freedom begins
Jan 2002	USS Carl Vinson / CCG-3 returns from deployment

K-Web Assessment Goals Aboard USS Carl Vinson

Use

- **How was it being used?**
- **Who was using it and where?**
- **How often was it used?**

Utility

- **Did it meet users' needs?**
  - » **If so, did it do so adequately?**

Usability

- **Were there usability problems?**

What improvements are needed?

What are the "hard" issues?

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Data Collection

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Automated data collection

- SumMaker and TacGraph tools record use (Producers)
- Microsoft IIS web server tracks use (Consumers)

Interviews and discussions

- Post workup
- Early deployment
- Late deployment
- Post deployment

Anecdotal reports

K-Web Highlights

K-Web Experienced Significant Use During Operation Enduring Freedom!

Access during period 28 Sep 01 – 29 Nov 01:

- **2684 unique IP addresses* accessed K-Web server during analysis period (2 Months)**
- **1322 visitors* visited K-Web more than once**
- **1755 visitors* bookmarked K-Web content for future access**

Activity per day:

- **Average of 482 visitors* per day**
  - **Ranged from 340 – 676 per day.**
- **Info flow / data transfer**
  - **Average data transferred per day (444.45 MB)**
  - **Vast majority of data transfers took place "in-house" (over ship's internal network)**
    - **Graphics / photos / imagery**
    - **Multi-media / movie files**
  - **No discernable impact upon the network was reported by users in spite of the large amount of data transferred**

* See speaker notes for important information on the terms "IP Address," "user," and "visitor."

K-Web Consumers during OEF

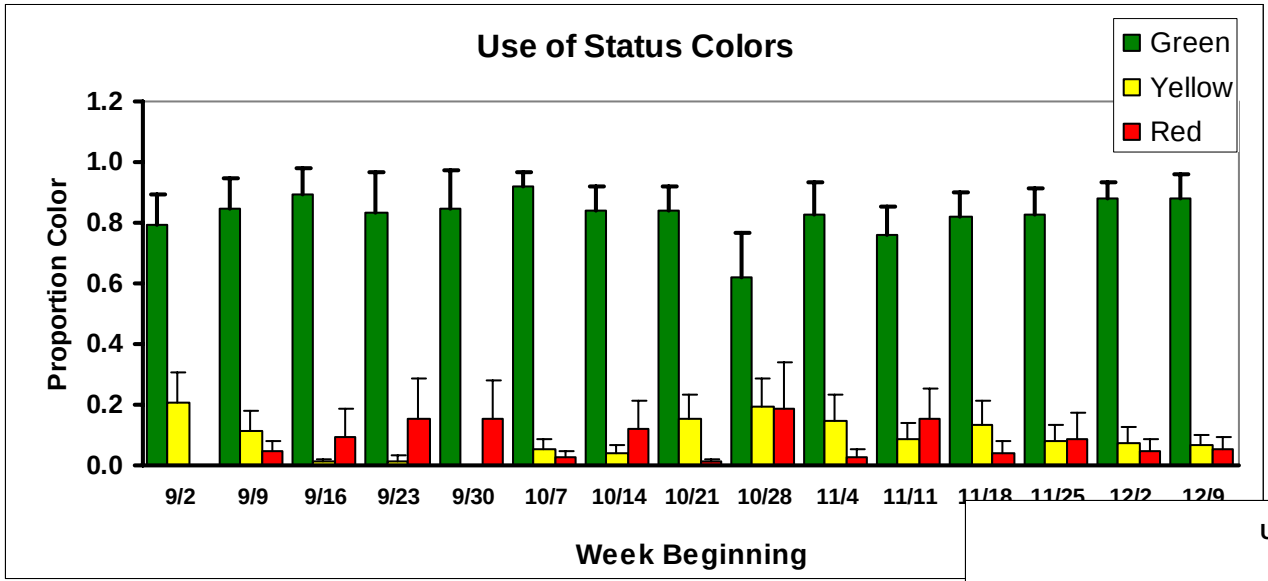
Most K-Web users internal to USS Carl Vinson (CCG-3 staff)

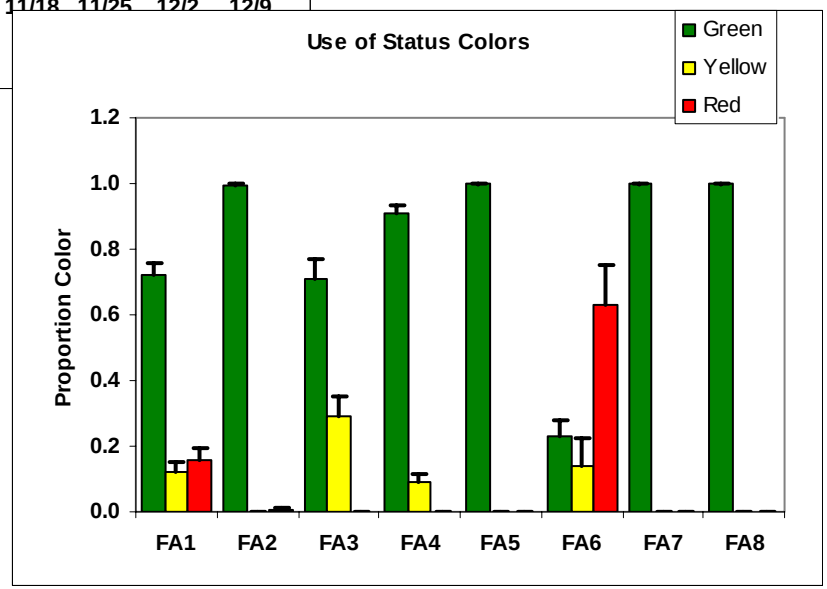
Many other Commands accessed / viewed / provided links to the K-Web

(based on unique Domain names / IP addresses accessing K-Web)

- Carl Vinson BG
- 5th Fleet
- 7th Fleet
- Various METOC commands
- CENTCOM
- Collaboration at Sea systems
- CINCPACFLT
- Peleliu ARG
- Theodore Roosevelt BG
- SOCOM
- NAVCENT
- USS Blue Ridge
- Various Pentagon offices / users, multi-service
- Enterprise BG
- Essex ARG
- DIA
- PACOM
- II MEF
- 15 MEU
- Various Air Force Commands
- ***Numerous Commands listed by IP address only…***

Use of Colors to Indicate Status in Summary Pages





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Alerting Users to Changes

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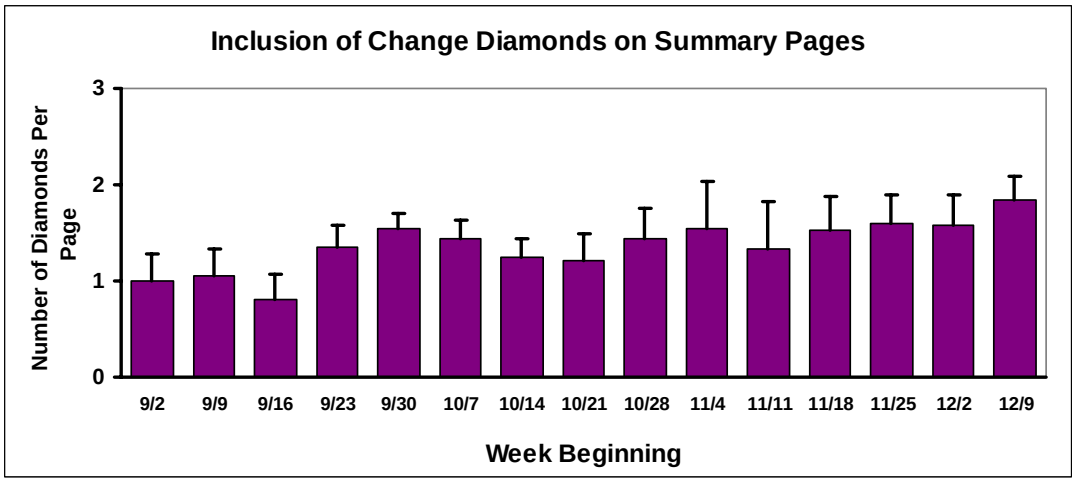
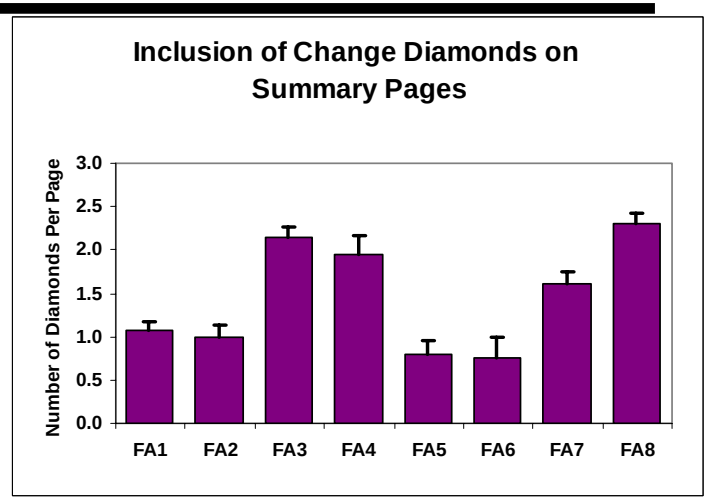
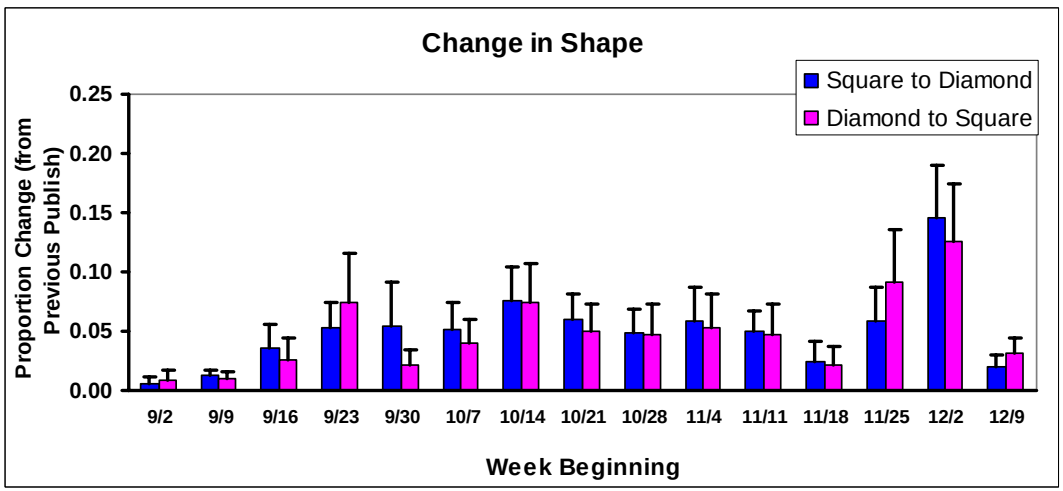
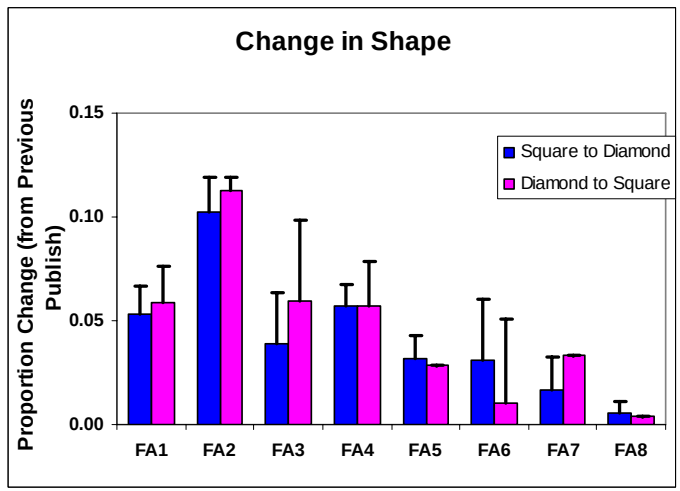
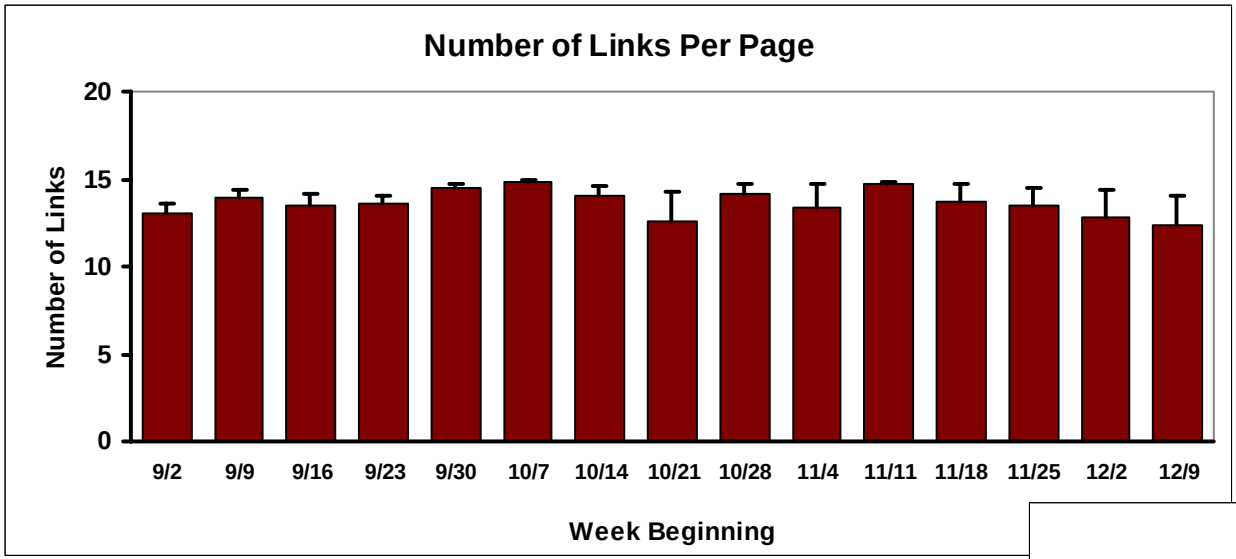


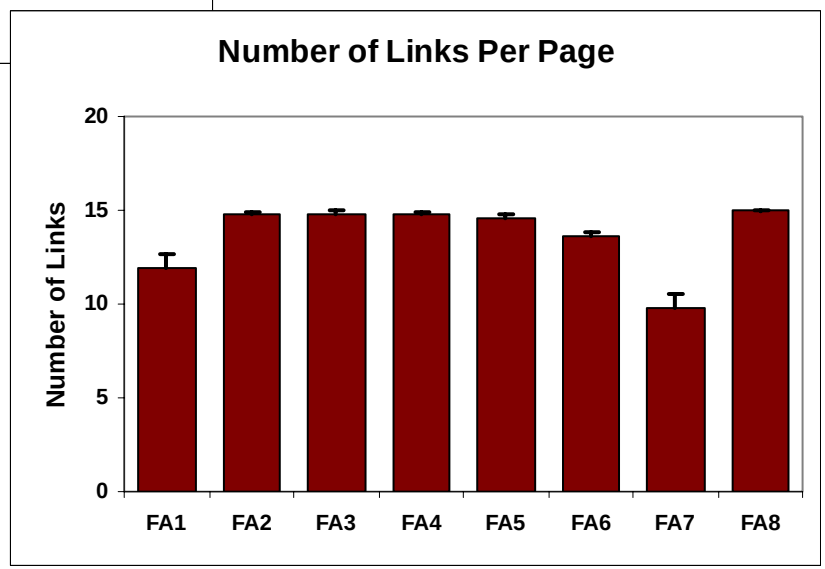






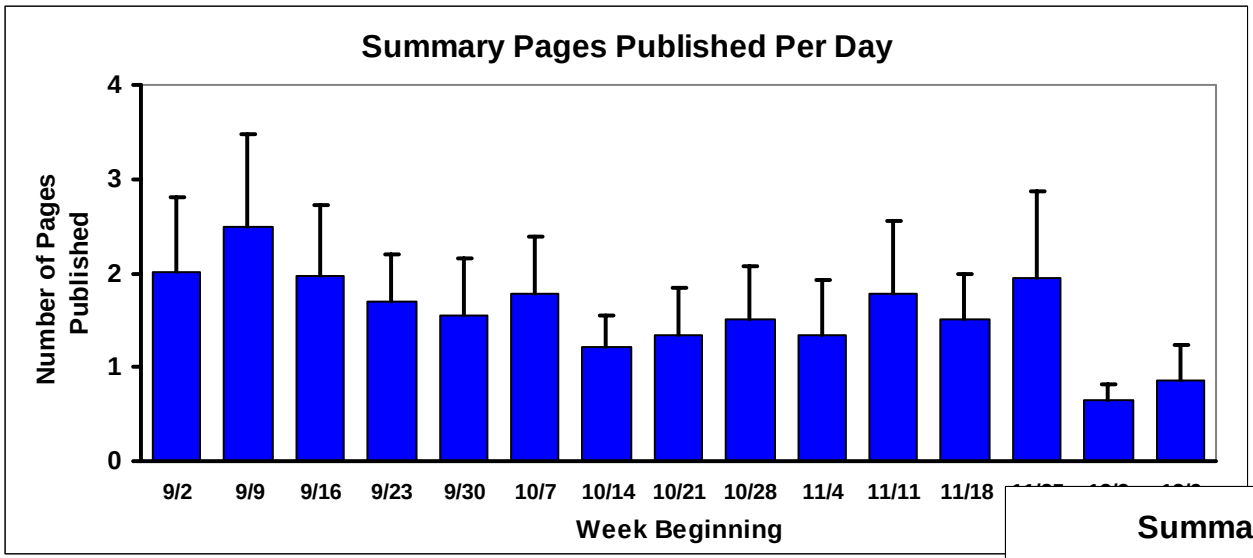
Linking to Mission-Relevant Information

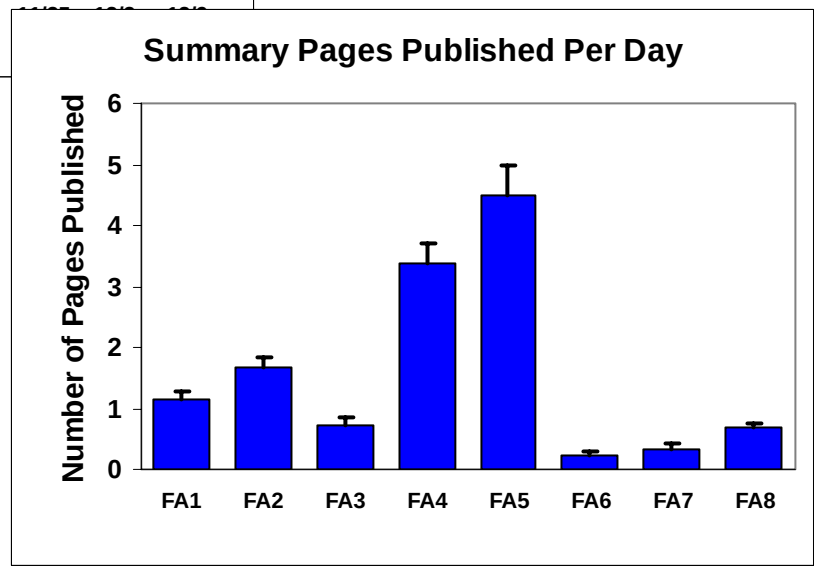




Near Real-Time Data

Publish Rates of Top-Level Summary Pages





Impact of K-Desks and Wall

Selected Quotes from OEF Users

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Pacific Science & Engineering

Multi-head display systems *[K-Desks in TFCC]* were a huge help – key enabler in managing all of the different information sources and multiple chats

- **Users reported monitoring up to 8 chat sessions simultaneously on the K-Desks. Users with traditional workstations unable to chat effectively and do any other tasks.**
- **K-Desks could accommodate simultaneous inputs from multiple tactical and information management systems**

"6-headed monsters" (as they were affectionately called) were a huge improvement over old display systems. Command-level watch standers need all the display space they can get…

Fantastic tool – always up – no maintenance – easy to use – we'd never give these up!

Having the K-Web available on the VideoWall side by side with tactical data was powerful. We could see the "big picture" and the fine details at the same time… Really helped us get S.A.

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More Operational Quotes regarding K-Web

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- K-Web Tool Training was easy – 15-30 minutes tops!
- This was an operator's dream – way better than other systems I've used…
- Used K-Web and Chat as primary communications channel – never did use BG Command (verbal communications circuit)
- Using K-Web meant breaking old habits and actually sharing information with others – K-Web and SumMaker made that easy…
- Very little resistance to K-Web – took about one day to adopt at the Command- and staff-levels
- Never did a PowerPoint brief during the deployment (per se). K-Web was a huge time-saver!

Operational Impact of K-Web

Selected Quotes from OEF K-Web Users

- During morning meetings we focused on problem solving rather than reviewing PowerPoint briefs…
- K-Web was so powerful because you could find the information you needed with just a click or two – not like other (traditional) systems…
- K-Web and chat filled the bill… We didn't even notice when radio circuits went down – because we weren't using them!
- Using K-Web meant breaking old habits and actually sharing information with others – K-Web and SumMaker made that easy…
- K-Web was up and operational the entire deployment – not a single failure…
- Multi-head display systems *[K-Desks in TFCC]* were a huge help – key enabler in managing all of the different information sources and multiple chats

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But… Some Issues Remain

Selected Quotes from OEF K-Web Users

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K-Web became so useful, so quickly, the entire region became dependent on it… When USS Carl Vinson left, a huge information vacuum resulted.

- **Transition and continuity of business rules, content, lessons learned, etc.**

Some units couldn't always see the K-Web due to connectivity and bandwidth limitations

Who is content created for and how is access control maintained?

No easy way to share K-Web with the Coalition Forces

- **Hardest part is knowing *what* to share and *how* to share it…**

Additional K-Web Templates & Concepts Under Development

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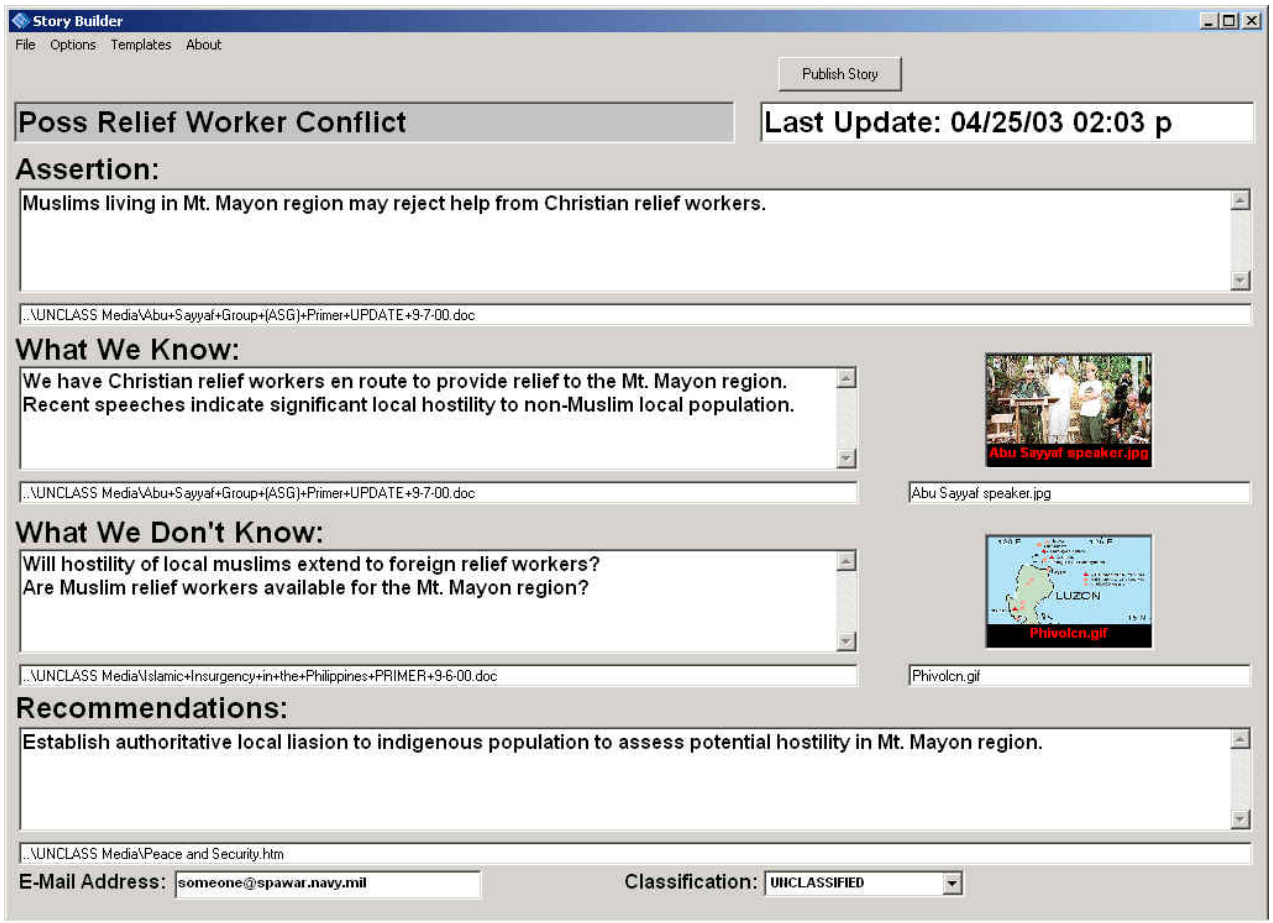
Example: "StoryBuilder" Template

Information is structured such that it forms the basis of an "argument" or "story"

Embedded links take the viewer to more detailed information supporting the assertion, facts, and conclusion.



Knowledge Web Technologies FNC Transition Plans

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- Deliver to SPAWAR PMW-157 a functional K-Web ready for Program of Record (POR) ASAP.
- Exit criteria based on performance metrics established during Enduring Freedom combat operations with the K-Web “IIS Functional Specification”.
- Transition occurs when PMW-157 (or their designated agent) begins funding development / deployment.

Emerging K-Webs (FY03)

- **Fleet – Operational K-Webs for all Fleet users being integrated with Collaboration At Sea (CAS) Fleet Initiative – Formal transition to SPAWAR PD-15 as POR.**
  - **USS Constellation BG: 9/02**
  - **USS Theodore Roosevelt BG: 10/02**
  - **USS Nimitz BG: 10/02**
  - **USS Carl Vinson BG: TBD**
- **EUCOM – Prototype "Operational" K-Web being developed by J6 (SIPR / JWCS)**
- **USTRANSCOM-Developing comprehensive Knowledge Management System**
- **CENTNAV- Prototype IIS-based K-Web for J6 being developed.**
- **OPNAV N6- RFP for IT21-based Program Management K-Web**
- **Singapore Military – Inquired about joint K-Web R&D**
- **DARPA AugCog – Building Program Management K-Web (NIPR).**
- **SECDEF- (Under Discussion)**

K-Web Lessons / Recommendations

- **Consider organizing around mission functions**
  - **Makes command Scaleable, Adaptable**
  - **Works well with web technologies**
- **K-Web works best when:**
  - **Endorsed by Commander: "The Web is the brief"**
  - **There is a recognized Command "Knowledge Manager" vested with authority & responsibility for process & products (N35 or ?)**
- **Know who is using whose information products, for what & when**
  - **Consider different enclaves of users (Coalition, Higher echelon, work groups) Try to accommodate them appropriately in your business model.**
- **Establish processes to work processes & products**
  - **Do it early, Do it periodically**
  - **Look for products that are updated regularly and widely used – then look for ways to streamline**
  - **Look for products that are not being used – assess their value and why**
  - **Look for product redundancy and then ways to combine to reduce task load**
  - **Look for products that are taking too much effort – assess their requirements**
- **Become aware of connectivity & bandwidth issues & educate the staff**
- **Look for tools that are easy to use and share as needed**
- **Develop and distribute business rules for how you want to work as a command**
- **Look for and recognize significance of unintended consequences**

Developing a Knowledge Management & Decision Support System

- **Define Prospective Scope, Tasking and Execution Plan**
- **Conduct Knowledge Engineering**
  - **Identify Key Staff members & Interview**
  - **Identify, Problems, Potential improvements & Costs.**
  - **Document current & Define prospective processes**
  - **Define opportunities for improvements & Implementation Issues**
  - **Identify categories of "users"**
  - **Identify subset(s) of staff as prototype users**
- **Implement Changes**
  - **Define & Engineer Hardware & Physical Environment**
  - **Define & Engineer Software Tools / Processes**
  - **Define CONOP & Validate Processes**
- **Assess Impacts & Utility**
  - **Define Metrics & Exit Criteria**
- **Iterate (add users) & Refine**

K-Web Summary

- **K-Web & K-Desks were used effectively aboard USS Carl Vinson during Operation Enduring Freedom**
- **Issues were identified for future research and development**
  - **Underlying concepts being further addressed / explored via current and future Office of Naval Research *Command 21* research project**
  - **Transition efforts taking place under ONR's Knowledge Superiority & Assurance Future Naval Capability program**
- **K-Web being transitioned to the Fleet as rapidly as possible through integration with Collaboration At Sea project.**
  - **Sponsored by the Office of Naval Research Future Naval Capabilities Program.**
  - **Working with Space and Naval Warfare System Command as transition partner.**

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Fleet K-Web Users

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www.pacific-science.com/kmds
www-tadmus.spawar.navy.mil

USS Carl Vinson
(and Battle Group Units)

USS Constellation
(and Battle Group)